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News from the Savannah River National Laboratory

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Nuclear Production of Hydrogen Holds Promise for Energy Future

AIKEN, S.C. – Using hydrogen produced in a nuclear plant to fuel our cars would be a viable part of an overall future energy strategy for the nation, according to a study just published by the Savannah River National Laboratory. The study found that nuclear production of hydrogen holds considerable promise, both from a technological and an economic viewpoint, although its authors stress that considerable research and development is still needed to make hydrogen practical for wide-spread use to power homes, cars and industry.

Nuclear production of hydrogen would take advantage of the heat produced by nuclear reactors to ‘crack’ water, breaking it into hydrogen and oxygen. The hydrogen could then be used as a clean, environmentally friendly transportation fuel to replace imported petroleum. This method has the potential to efficiently produce large quantities of hydrogen, using domestic resources and without producing greenhouse gases and, hence, to play a significant role in meeting the goals of the President’s Hydrogen Fuel Initiative.

The report covers the first phase of a three-year project to examine both the technical and the economic issues surrounding the use of nuclear power to produce hydrogen. The study, entitled "Centralized Hydrogen Production from Nuclear Power: Infrastructure Analysis and Test-Case Design Study," is funded by the U.S. Department of Energy Office of Nuclear Energy, Science & Technology as part of the Nuclear Energy Research Initiative (NERI).

SRNL is conducting the study in collaboration with its university partner, the University of South Carolina, along with industrial partners General Atomics and Entergy Nuclear, the Argonne National Laboratory, and various consultants. The entire report can be viewed on the NERI website at neri.ne.doe.gov/.

“One of the biggest challenges in bringing hydrogen into widespread use is: How do we produce enough hydrogen to meet the need?” says Dr. Bill Summers, Hydrogen Program Manager for SRNL and one of the authors of the study. “Hydrogen is all around us, but it usually exists in combination with other elements in forms such as water molecules or molecules of hydrocarbons. You have to have a way to get it out, and that requires energy.

“No one single method of producing hydrogen will be the answer for all our needs,” he adds. “Nuclear production could be an important part of the mix because of its advantages, such as the use of domestic resources and no production of greenhouse gases.”

The scenario being studied in this project combines a high-temperature, helium-cooled nuclear reactor, based on a design by General Atomics, with a thermochemical water-splitting process to break water into oxygen and hydrogen. A pipeline would carry the hydrogen from this centralized nuclear hydrogen plant to fueling stations,

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where end-users would fuel up their hydrogen fuel-cell vehicles. Some of the hydrogen could also be sold to large industrial hydrogen users, such as ammonia plants and oil refineries. There is also a potential market for the oxygen produced when the water is split.

The economics of nuclear hydrogen use by industrial users look particularly attractive, according to the study, which estimates hydrogen costs competitive with the cost of producing hydrogen from natural gas at current prices. As natural gas prices continue to rise and environmental regulations on greenhouse gases become more restrictive, hydrogen from nuclear energy will become the economic choice for industrial users.

In the next phase of the study, a site-specific, pre-conceptual design of a nuclear hydrogen production plant will be developed. The test-case design will provide for a more detailed evaluation of nuclear hydrogen production, including plant design and site selection issues, integration with an existing industrial hydrogen end-user, sizing and characterization of hydrogen storage and pipeline transmission systems, identification and evaluation of other hydrogen infrastructure issues, and a detailed economic assessment.

SRNL, the applied research and development laboratory at the Savannah River Site, has over a half century of experience with hydrogen (and its radioactive form, tritium) in support of the nation's defense. In recent years, the laboratory has been applying that expertise to develop hydrogen as a practical means of supplying the nation's future energy needs.

Washington Savannah River Company operates SRNL for the U.S. Department of Energy.

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